# Technology Demonstration Fact Sheet

## *Gamma Ray Imaging*


**SUMMARY**

The Laser Assisted Ranging and Data System (LARADS) was used to demonstrate indoor radiation mapping of a radiological survey of a preselected room in the 105-C Reactor Building. The baseline method employs hand sketches that show the walls and floors with a superimposed crude grid. Both the baseline and innovative methods use similar hand-held radiation detectors. With the baseline method, activity measurements above release levels are noted on the hand sketches. With the innovative method, all activity measurements are electronically recorded and can be superimposed on CAD drawings or digital photos of the walls and floor. The location of each reading is recorded using a laser-assisted mapping system (similar to that utilized by civil land surveyors for mapping geographical locations).
Results of the baseline demonstration and technical demonstration were as follows:

- Beta/gamma hot spots were identified and mapped for the floor with both methods; no alpha above the release limit was detected.
- The walls of the room were within survey release limits with both the baseline and innovative methods. However, the baseline scanning speed was higher (6 inches/second vs. 2 to 3 inches/second); with the innovative method virtually total coverage was achieved and the actual coverage is verifiable.
- Total labor for the baseline field survey and reporting was 5.75 person hours (equivalent to 8.5 hours at the slower scanning speed); for the innovative method 8 hours including a report comparable to the baseline and 11 hours with a more complete report.
- The innovative method produces more useable data with greater accuracy and reproducibility with respect to locating measured activity levels. The maps produced are more reliable for auditing or regulatory review of release surveys and for ongoing D&D work.

This technology will increase productivity, decrease man-hours, and provide a clearer, more understandable product for the decision-making process.


**INNOVATIVE TECHNOLOGY DESCRIPTION**

The LARADS is based on an integration of a modified auto-tracking civil surveyors total station with a radiological detection system and storage of the information obtained from each into electronic files. These files can be used with Geographic Information System software to produce survey records or reports. These reports can be both graphical, with color-coded radiological levels overlaid on an AutoCAD drawing or a digital photograph of the room, or textual, with all radiological readings stored within a database along with x, y, and z positional coordinates.

The LARADS removes the technician's subjective observations from the radiological survey process, both in the data collection and report generation processes.

**BASELINE DEMONSTRATION DESCRIPTION**

Thermo Hanford Inc. Radiological Control personnel performed a scanning-type survey of the laundry sorting room, using a pancake Geiger Mueller detector.

This room had been previously cleared of equipment and was ready for release survey.

The interior walls of the room were surveyed to a height of approximately eight feet from floor surface and the floor surface was surveyed in its entirety.

Areas found that contained elevated beta readings were static checked for beta/gamma activity and also static checked with a PAM with a zinc sulfide scintillation sensor for alpha radiation. Hot spot areas are normally marked with paint to identify the contaminated areas for future references.

A hand-written radiological survey report was generated containing information regarding the conduct of the survey such as date, time, instruments used, location, etc. as well as the survey results. This report included a hand-drawn sketch of the surveyed area with associated radiological contamination levels.

**LARADS DEMONSTRATION DESCRIPTION**

The LARADS and other Radiological Control personnel were deployed in the same room, and conducted a survey of the same area using a portable counter/scaler meter outfitted with a plastic scintillate/zinc sulfide detector capable of detecting both alpha and beta radiation, either simultaneously or separately. The instrument was calibrated by Pacific Northwest National Laboratory. A beta scan survey was conducted moving the detector at a speed of 2-3 inches per second. Any area that showed evidence of elevated levels of radioactivity was static counted for both beta and alpha radiation.

Testing of the LARADS survey reproducibility (or repeatability) features was conducted by revisiting the localized "hot spot" identified on the floor.

Upon completion of survey field activities, the survey files were downloaded from the field system computer into an office-based GIS system for analysis and report generation.

The report generated included maps of each surveyed wall, with the radiological readings overlaid in color. Locations where static scaler-type readings were obtained were identified and results of these given.

A database electronic file was provided that included every reading obtained from each surface along with the file ID, readings, and coordinate information.

**DETAILS OF BENEFITS**

LARADS survey reports will provide a more clear, concise and understandable representation of exactly where and how much contamination is present in an area. These data can be used for job planning, release documentation and decontamination activities, as well as loading into dose assessment software packages.

The LARADS is capable of interfacing different kinds of radiological detectors, allowing it to be used for dose rate surveys, neutron surveys, etc., as well as removable and fixed contamination surveys.

**SUCCESS CRITERIA**

- More radiological data acquired and stored in database format.
- Clear, concise, easily understood graphics of survey data.
- Subjective observations/errors reduced.
- Better contaminant mapping reproducibility.

**SCHEDULE/COST**

The demonstration was conducted on February 14 and 19, 1997. Using site personnel, the total cost to perform this demonstration was approximately $900 including data processing.

**FUTURE APPLICABILITY**

This technology will be primarily used to provide well-documented clearance surveys of walls, floors and ceilings of contaminated/potentially contaminated buildings/structures prior to decommissioning/ demolition. The system may be used both on interior and exterior surfaces. The precision and quality of the survey documents will expedite regulatory review and negate the need for questioning and confirmatory surveys. When a large surface area or room is required to be surveyed, the system can be configured with large detectors on a mobile platform, which will greatly enhance productivity without compromising the quality of the data. The system may also be configured with high-level radiation detectors and used for investigating and documenting more extreme radiological conditions.

**Laser Assisted Ranging And Data System (LARADS) Demonstration Compared to Baseline**

(Hours shown are person-hours)

| ACTIVITIES | BASELINE | LARADS |
|---|---|---|
| Field time (Survey)[1] | Equivalent to 7.4 hrs | 6 hrs |
| Coverage of Area [1] | ~100% | ~100% |
| Setup [2] | 0.33 hrs | 1 hrs |
| Calibration [3] | Same | Same |
| Report Preparation | 0.75 hrs | 1 hr for basic data display, 4 hrs for enhanced. |
| Report Archiving | Hard Copy, Microfilming [4] | Electronic Format |
| Report Clarity | Moderate | High |
| Reproducibility [5] | Subjective | Easy |
| Ease of Use | Skill of craft | Relatively Easy to Learn |

NOTES:
1. Survey time is a function of the survey speed, radiological background, and detector size. The baseline survey took
2. 3.1 hours and was performed at a scan speed of 6 inches/second that is typically applied for characterization surveys, not release surveys. The equivalent baseline time was estimated to be 7.4 hours when corrected to a scan speed of 2 to 3 inches/second.
3. Setup, as used to describe baseline, includes time to layout grid lines prior to survey and is highly dependent upon size of surface area to be surveyed. LARADS setup is time to level tripod and connect system cabling and is <20 minutes per room regardless of size.
4. The LARADS radiological detection sub-system is easier to calibrate than the baseline rad detection meter. The LARADS CRM can be calibrated to an alpha/beta detector in <45 minutes.
5. Costs to prepare and maintain records unknown.
6. Reproducibility is defined as the ability to return to the same precise location after passage of time to compare readings.

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